Cleco Corporation
Brame Energy Center
Teche Power Station

CLECO®

CALPUFF Modeling Report
BART Applicability Screening Analysis

Submitted to:

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and

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1. EXECUTIVE SUMMARY

This report documents the air dispersion modeling analysis conducted in support of Best Available Retrofit Technology (BART) applicability screening for Cleco Corporation (Cleco). The screening modeling analysis was performed for all three BART-eligible emission units at Cleco's two electric power generating stations in Louisiana (LA): [1]

- Nesbitt I (Brame Unit 1) is a 440-MW EGU boiler located at Brame Energy Center (formerly known as Rodemacher Power Station) that burns natural gas[2] and is not equipped with any air pollution control devices (APCDs).

- Rodemacher II (Brame Unit 2) is a 523-MW wall-fired EGU boiler also located at Brame Energy Center that burns PRB coal. This unit has recently been retrofitted with several APCDs:
  - LNB was installed several years ago;
  - SNCR was installed about one year ago for complying with ozone season NO_x requirements of CSAPR; and
  - DSI (trona injection) was installed recently for compliance with the upcoming MATS HCl limit.

- Teche III (Teche Unit 3) is a 359-MW EGU boiler located at Teche Power Station. This unit burns natural gas, No. 2 fuel oil, and No. 4 fuel oil and is not equipped with any APCDs.

Two of the above sources were listed among the 12 BART-affected sources in the LA Regional Haze State Implementation Plan (SIP).[3] Brame Unit 2, previously not listed as a BART-affected source in the SIP, is included in this analysis as it has since been identified as a BART-eligible source. According to the LA SIP, one or more of the 12 BART-affected sources were determined to cause orcause or contribute to visibility impairment in two Class I Areas: Breton (BRET) and Caney Creek (CACR). Since Brame Units 1 and 2, and Teche Unit 3 meet the three criteria that make a source BART-eligible, these units were evaluated for BART applicability by modeling visibility impacts with respect to Breton and Caney Creek The BART applicability of Cleco's sources is based on the aggregate of BART-eligible units at each facility.

A summary of the existing visibility impairment attributable to each facility based on the default natural conditions is provided in Table 1-1. The visibility impairment summarized in Table 1-1 is based on recent modeling using emissions data based on a combination of stack testing, and Continuous Emission Monitoring System (CEMS) data as further described in Section 4 of this report.

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[1] These sources are one of the listed 26 BART source categories, were in existence on August 7, 1977, began operation after August 7, 1962, have potential emissions greater than 250 tpy of PM, NO_X, or SO_2, and contribute to visibility impairment in at least one Class I area.

[2] Unit 1 is currently also permitted to combust oil, but it has not in several years, and, due to the MATS rule, will not combu st oil in the future.

[3] LDEQ, Louisiana Regional Haze SIP, June 2008: http://www.deq.louisiana.gov/portal/DIVISIONS/AirPermitsEngineeringandPlanning/AirQualityPlanning/LouisianaSIPRevisions/LouisianaRegionalHazeSIP.aspx

Table 1-1. Existing Visibility Impairment (2001-2003)

Unit	CACR		BRET	
	98th % Δdv	Days > 0.5 Δdv	98th % Δdv	Days > 0.5 Δdv
Brame, Units 1 and 2	1.215	100	1.060	50
Teche, Unit 3	0.106	0	0.299	1

Based on the results of this screening analysis, absent any further analysis,[4] Brame Units 1 and 2 are determined to be BART-affected emission units. Visibility impacts from Teche Unit 3 are less than the 0.5 Δdv screening threshold, and therefore, is not subject to BART.

[4] Cleco is considering options for alternate analyses (e.g., using CAM_X) that may potentially demonstrate inapplicability.

2. INTRODUCTION AND BACKGROUND

In the 1977 amendments to the Clean Air Act (CAA), Congress set a national goal to restore national parks and wilderness areas to pristine conditions by preventing any future, and remedying any existing, man-made visibility impairment. On July 1, 1999, the U.S. EPA published the final Regional Haze Rule (RHR). The objective of the RHR is to restore visibility to pristine conditions in 156 specific areas across the United States known as Class I areas. The CAA defines Class I areas as certain national parks (larger than 6,000 acres), wilderness areas (larger than 5,000 acres), national memorial parks (larger than 5,000 acres), and international parks that were in existence on August 7, 1977.

The RHR requires States to set goals that provide for reasonable progress towards achieving natural visibility conditions for each Class I area in their state. On July 6, 2005, the EPA published amendments to its 1999 RHR, often called the Best Available Retrofit Technology (BART) rule, which included guidance for making source specific BART determinations. The BART rule defines BART-eligible sources as sources that meet the following criteria:

(1) Have potential emissions of at least 250 tons per year of a visibility-impairing pollutant,
(2) Began operation between August 7, 1962 and August 7, 1977, and
(3) Are included as one of the 26 listed source categories in the guidance.

A BART-eligible source is subject to BART if the source is "reasonably anticipated to cause or contribute to visibility impairment in any federal mandatory Class I area." EPA has determined that a source is reasonably anticipated to cause or contribute to visibility impairment if the 98th percentile visibility impacts from the source are greater than 0.5 delta deciviews (Δdv) when compared against a natural background. Air quality modeling is the tool that is used to determine a source's visibility impacts. Once it is determined that a source is subject to BART, a BART determination must address air pollution control measures for the source. A BART determination for Cleco's BART-applicable sources will be addressed under separate cover.

In 2008, LDEQ submitted the regional haze state implementation plan (SIP) to address emissions that contribute to regional haze, and on May 30, 2012, EPA issued a final limited disapproval of the SIP. Cleco is providing this BART screening analysis to assist LDEQ in the development of a revised SIP.

MODELING PROTOCOL BACKGROUND

The refined modeling analyses presented in this report was conducted in accordance with the Sid Richardson modeling protocol provided by EPA.[5] It is worth noting that the modeling methodologies utilized in this analysis are nearly identical to those used in the recent Arkansas BART analyses, with the exception of the following CALPUFF parameters dictated by the Sid Richardson protocol:

- Geometric mass mean diameter (Input Group 8), PMC = 0.48
- Wet deposition scavenging coefficient for liquid precipitation (Input Group 10), SO_2 = 3.0 E -05 s^{-1}
- Monthly ozone concentrations (Input Group 11), BCKO3 = 80 ppb *12

[5] Wren Stenger, letter to Darren Olagues, 19 May 2015. Enclosure 2: CALPUFF Modeling Requirements and Protocols.

There is one deviation from the Sid Richardson protocol in this analysis with respect to the minimum vertical turbulence velocities (i.e., SWMIN in Input Group 12). Thedefault SWMIN parameter was modeled as follows and was approved by EPA:[6]

SWMIN = 0.200, 0.120, 0.080, 0.060, 0.030, 0.016, 0.200, 0.120, 0.080, 0.060, 0.030, 0.016

This refined screening analyses evaluates the visibility impacts for two Class I areas: Caney Creek Wilderness (CACR) and Breton Wilderness (BRET). As this is a refined modeling analysis, the existing CENRAP CALMET dataset with observations was utilized. Further detail on the modeling methodologies are presented in the next section.

[6] Erik Snyder (EPA Region 6), email to William Matthews (Cleco), June 12, 2015.

3. MODELING METHODOLOGIES AND PROCEDURES

This section summarizes the dispersion modeling methodologies and procedures applied in this refined screening analysis. All dispersion modeling has been conducted using the CALPUFF modeling system, consisting of the CALPUFF dispersion model, the CALMET meteorological data processor, and the CALPOST post-processing program.

CALPUFF is a multi-layer, multi-species, non-steady-state puff dispersion model, which can simulate the effects of time and space varying meteorological conditions on pollutant transport, transformation, and removal. CALPUFF uses three-dimensional meteorological fields developed by the CALMET model. In addition to meteorological data, several other input files are used by the CALPUFF model to specify source and receptor parameters. The selection and control of CALPUFF options are determined by user-specific inputs contained in the control file. This file contains all of the necessary information to define a model run (e.g., starting date, run length, grid specifications, technical options, output options). CALPOST processes concentration, deposition, and visibility impacts based on pollutant specific concentrations predicted by CALPUFF.

MODEL VERSIONS

The versions of the CALPUFF modeling system that were utilized in this analysis are shown below in Table 3-1.

Table 3-1. CALPUFF Modeling System Versions

Processor	Version	Level
CALMET[1]	5.53a	40716
CALPUFF	5.8.4	130731
POSTUTIL	1.56	070627
CALPOST	6.221	080724

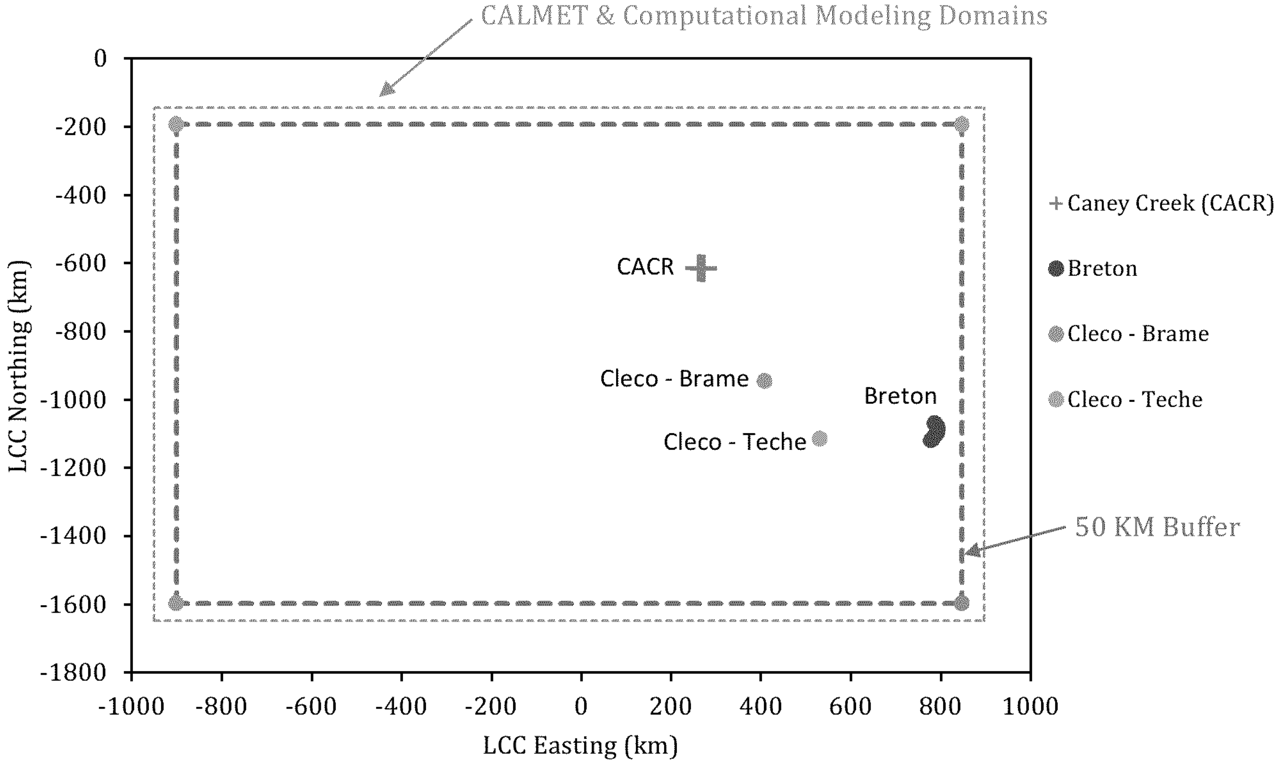
[1]CALMET dataset with observations utilized in Oklahoma and Arkansas BART analyses

MODELING DOMAIN

The CALPUFF modeling system utilizes three modeling grids: the meteorological grid, the computational grid, and the sampling grid. The meteorological grid is the system of grid points at which meteorological fields are developed with CALMET. The computational grid determines the computational area for a CALPUFF run. Puffs are advected and tracked only while within the computational grid. The meteorological grid is defined so that it covers the areas of concern and gives enough marginal buffer area for puff transport and dispersion.

A plot of the meteorological modeling domain for the existing CENRAP CALMET dataset with respect to Cleco's BART-eligible sources and the Class I areas being modeled is provided in Figure 3-1. The computational domain is set equal to the meteorological domain (as done in Arkansas BART modeling) and extends at least 50 km in all directions beyond Brame Energy Center, Teche Power Station, and the Class I areas of interest.

Figure 3-1. Refined Meteorological Modeling Domain



CALMET AND CALPUFF

The CALPUFF data and parameters are based on theSid Richardson protocol provided by EPA. The existing CALMET dataset with observationsapproved by EPA was utilized. This meteorological dataset was used by EPA for SIP/FIPs in Oklahoma and Arkansas.

Receptor Locations

Receptor locations and elevations for Caney Creek and Breton were downbaded from the National Park Service website.[7]

Background Ozone

Background ozone concentrations are required in order to model the photochemical conversion of SO_2 and NO_X to sulfates (SO_4) and nitrates (NO_3). CALPUFF can use either a single background value representative of an area or hourly ozone data from one or more ozone monitoring stations. Hourly ozone data files were used in these CALPUFF simulations. The ozone data files were developed according to the CALPUFF User's Guide (Version 5) Section 4.8and are based on data obtained from

[7] National Park Service, Class I Receptors: http://nature.nps.gov/air/maps/Receptors/index.cfm

EPA's AirData website for thirty-three monitors (see Table 3-2) over the 2001-2003 timeframe. Hourly ozone files are included on the attached CD in Appendix A.

In addition, the monthly value was set to 80 ppb per EPA's modeling protocol.[8] This value is only used by the model if there are missing hourly ozone records.

Post-processing

Hourly concentration outputs from CALPUFF were processed through POSTUTIL and CALPOST to determine visibility conditions. A three-year CALPOST analysis was conducted to determine the visibility change in deciview (dv) caused by Cleco's BART-eligible sources when compared to a natural background.

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[8] Wren Stenger, letter to Darren Olagues, 19 May 2015. Electronic Attachments to Enclosure 2: Sid Richardson CALPUFF model file, "Epa6calpuff.inp".

Table 3-2. Ozone Monitors

AQS Site ID	Lat (Deg)	Lon (Deg)	State	County	City	Address
22-087-0002	29.981944	-89.998611	Louisiana	St. Bernard	Not in a city	Mehle Ave., Arabi
22-071-0012	29.994444	-90.102778	Louisiana	Orleans	New Orleans	Corner of Florida Ave & Orleans Ave
22-051-1001	30.043573	-90.275091	Louisiana	Jefferson	Kenner	West Temple Pl
22-089-0003	29.984167	-90.410556	Louisiana	St. Charles	Hahnville	1 RIVER PARK DRIVE
22-095-0002	30.058333	-90.608333	Louisiana	St. John the Baptist	Not in a city	Anthony F. Monica Street
22-093-0002	29.994444	-90.82	Louisiana	St. James	Not in a city	ST. JAMES COURTHOUSE, HWY 44 @ CANAPELLA
22-057-0004	29.763889	-90.765183	Louisiana	Lafourche	Thibodaux	Nicholls University Farm Highway 1
22-101-0003	29.715278	-91.21	Louisiana	St. Mary	Morgan City	1300 LAKEWOOD DR. ST. MARY PAR. SHERIFF
22-063-0002	30.3125	-90.8125	Louisiana	Livingston	Not in a city	Highway 16, French Settlement
22-005-0004	30.233889	-90.968333	Louisiana	Ascension	Not in a city	11153 Kling Road
22-047-0009	30.220556	-91.316111	Louisiana	Iberville	Not in a city	65180 Belleview Road
22-033-0003	30.419763	-91.181996	Louisiana	East Baton Rouge	Baton Rouge	EAST END OF ASTER LANE
22-033-0009	30.46198	-91.17922	Louisiana	East Baton Rouge	Baton Rouge	1061-A Leesville Ave
22-121-0001	30.500643	-91.213556	Louisiana	West Baton Rouge	Not in a city	1005 Northwest Drive, Port Allen
22-047-0007	30.4	-91.425	Louisiana	Iberville	Not in a city	HIGHWAY 77, GROSSE TETE
22-033-1001	30.593978	-91.251943	Louisiana	East Baton Rouge	Not in a city	Highway 964
22-033-0013	30.700921	-91.056135	Louisiana	East Baton Rouge	Not in a city	11245 Port Hudson-Pride Rd. Zachary, La
22-077-0001	30.681736	-91.366172	Louisiana	Pointe Coupee	Not in a city	TED DAVIS RESIDENCE. HIGHWAY 415
22-043-0001	31.5023	-92.4603	Louisiana	Grant	Not in a city	HIGHWAY 8
22-011-0002	30.491944	-93.143889	Louisiana	Beauregard	Not in a city	HIGHWAY 171 (5 MI SOUTH OF HWY 190)
22-019-0008	30.261667	-93.284167	Louisiana	Calcasieu	Westlake (RR name West Lake)	2646 John Stine Road
22-019-0002	30.143333	-93.371944	Louisiana	Calcasieu	Not in a city	HIGHWAY 27 AND HIGHWAY 108
22-019-0009	30.227778	-93.578333	Louisiana	Calcasieu	Vinton	2284 Paul Bellow Road
22-073-0004	32.509713	-92.046093	Louisiana	Ouachita	Monroe	5296 Southwest
22-017-0001	32.676389	-93.859722	Louisiana	Caddo	Not in a city	HAGOOD ROAD
22-015-0008	32.53626	-93.74891	Louisiana	Bossier	Shreveport	1425 Airport Drive
22-055-0005	30.2175	-92.051389	Louisiana	Lafayette	Lafayette	208 Devalcourt Street
05-097-0001	34.649722	-93.816667	Arkansas	Montgomery	Not in a city	FOREST RANGER STA QUACHITA NATL FOREST
28-045-0001	30.230167	-89.567444	Mississippi	Hancock	Not in a city	Port Bienville Industrial Park
22-047-0012	30.206985	-91.129948	Louisiana	Iberville	Not in a city	HIGHWAY 171, CARVILLE
48-361-1001	30.085263	-93.761341	Texas	Orange	West Orange	2700 Austin Ave
28-059-0006	30.378287	-88.53393	Mississippi	Jackson	Pascagoula	Hospital Road at Co. Health Dept.
28-047-0008	30.390369	-89.049778	Mississippi	Harrison	Gulfport	47 Maple Street

POSTUTIL

In the post-processing of CALPUFF-computed concentrations of visibility-affecting pollutants, the POSTUTIL post-processing utility was used to apply the ammonia limiting method (ALM) by re-partitioning the distribution of HNO_3 and NO_3 concentrations at each Class I area as a function of the temperature and relative humidity during each hour.

CALPOST

The CALPOST visibility processing completed for this BART analysis is based on the October 2010 guidance from the Federal Land Managers Air Quality Related Values Workgroup (FLAG). The 2010 FLAG guidance, which was issued in draft form on July 8, 2008 and published as final guidance in December 2010, makes technical revisions to the previous guidance issued in December 2000.

Visibility impairment is quantified using the light extinction coefficient (b_{ext}), which is expressed in terms of the haze index expressed in deciviews (dv). The haze index (HI) is calculated as follows:

$$HI(\mathrm{dv}) = 10\ln\left(\frac{b_{ext}}{10}\right)$$

The impact of a source is determined by comparing the HI attributable to a source relative to estimated natural background conditions. The change in the haze index, in deciviews, also referred to as "delta dv," or Δdv, based on the source and background light extinction is based on the following equation:

$$\Delta \mathrm{dv} = 10 * \ln\left[\frac{\mathrm{b}_{\mathrm{ext,\ background}} + \mathrm{b}_{\mathrm{ext,\ source}}}{\mathrm{b}_{\mathrm{ext,\ background}}}\right]$$

The Interagency Monitoring of Protected Visual Environments (IMPROVE) workgroup adopted an equation for predicting light extinction as part of the 2010 FLAG guidance (often referred to as the new IMPROVE equation). The new IMPROVE equation is as follows:

$$b_{ext} = \begin{array}{l} 2.2 f_S(RH)[\mathrm{NH_4(SO_4)_2}]_{\mathrm{Small}} + 4.8 f_L(RH)[\mathrm{NH_4(SO_4)_2}]_{\mathrm{Large}} + \\ 2.4 f_S(RH)[\mathrm{NH_4NO_3}]_{\mathrm{Small}} + 5.1 f_L(RH)[\mathrm{NH_4NO_3}]_{\mathrm{Large}} + \\ 2.8[\mathrm{OC}]_{\mathrm{Small}} + 6.1[\mathrm{OC}]_{\mathrm{Large}} + 10[\mathrm{EC}] + 1[\mathrm{PMF}] + 0.6[\mathrm{PMC}] + \\ 1.4 f_{SS}(RH)[\mathrm{Sea\ Salt}] + b_{\mathrm{Site-specific\ Rayleigh\ Scattering}} + 0.33[\mathrm{NO_2}] \end{array}$$

Visibility impairment predictions for Brame Unit 1, Brame Unit 2, and Teche Unit 3 relied upon in this BART analysis used the equation shown above. The use of this equation is referred to as "Method 8" in the CALPOST control file. The use of Method 8 requires that one of five different "modes" be selected. The modes specify the approach for addressing the growth of hygroscopic particles due to moisture in the atmosphere. "Mode 5" has been used in this BART analysis. Mode 5 addresses moisture in the atmosphere in a similar way as to "Method 6", where "Method 6" is specified as the preferred approach for use with the old IMPROVE equation in the CENRAP BART modeling protocol.

CALPOST Method 8, Mode 5 requires the following:

- Annual average concentrations reflecting natural background for various particles and for sea salt
- Monthly RH factors for large and small ammonium sulfates and nitrates and for sea salts
- Rayleigh scattering parameter corrected for site-specific elevation

Table 3-3 through Table 3-6 below show the values for the data described above that were input to CALPOST for use with Method 8, Mode 5. The values were obtained from the 2010 FLAG guidance.

Table 3-3. Annual Average Background Concentration

Class I Area	$(NH_4)_2SO_4$ (μg/m³)	NH_4NO_3 (μg/m³)	OM (μg/m³)	EC (μg/m³)	Soil (μg/m³)	CM (μg/m³)	Sea Salt (μg/m³)	Rayleigh (Mm^{-1})
CACR	0.23	0.1	1.8	0.02	0.5	3	0.03	11
BRET	0.23	0.1	1.78	0.02	0.48	3.01	0.19	11

Table 3-4. f_L(RH) Large RH Adjustment Factors

Class I Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CACR	2.77	2.53	2.37	2.43	2.68	2.71	2.59	2.6	2.71	2.69	2.67	2.79
BRET	2.91	2.76	2.74	2.72	2.83	2.94	3.10	3.07	2.97	2.82	2.83	2.90

Table 3-5. f_S(RH) Small RH Adjustment Factors

Class I Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CACR	3.85	3.44	3.14	3.24	3.66	3.71	3.49	3.51	3.73	3.72	3.68	3.88
BRET	4.08	3.82	3.79	3.74	3.94	4.12	4.41	4.37	4.18	3.92	3.93	4.06

Table 3-6. f_{SS}(RH) Sea Salt RH Adjustment Factors

Class I Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CACR	3.9	3.52	3.31	3.41	3.83	3.88	3.69	3.68	3.82	3.76	3.77	3.93
BRET	4.1	3.89	3.87	3.85	4.02	4.21	4.44	4.38	4.23	3.99	4.01	4.11

4. EXISTING EMISSIONS AND VISIBILITY IMPAIRMENT

This section summarizes the existing (i.e. baseline) visibility impairmentattributable to Brame Unit 1, Brame Unit 2, and Teche Unit 3 based on air quality modeling.

NO_X, SO_2, AND PM_{10} BASELINE EMISSION RATES

Table 4-1 summarizes the maximum 24-hour emission rates that were modeled for SO_2, NO_x, and PM_{10}, including the speciated PM_{10} emissions for 2000-2004.

Table 4-1. Baseline Emission Rates

Unit	SO_2 (lb/hr)	NO_X (lb/hr)	Total PM_{10} (lb/hr)	SO_4 (lb/hr)	PM_c (lb/hr)	PM_f (lb/hr)	SOA (lb/hr)	EC (lb/hr)
Brame, Unit 1	3,354.62	1,321.50	245.00	54.88	48.93	121.77	9.68	9.73
Brame, Unit 2	5,494.92	3,298.63	189.60	0.00	89.57	69.01	28.37	2.65
Teche, Unit 3	620.00	939.17	144.17	32.73	28.65	71.31	5.78	5.70

Brame Unit 1

The SO_2, NO_x, and PM_{10} emission rates for Brame Unit 1 were obtained from the previously submitted LA SIP (referred to as Rodemacher Power Station).[9] Speciated PM_{10} emission rates shown in Table 4-1 reflect the breakdown of the PM_{10} determined from the National Park Service (NPS) "speciation spreadsheet" for *Uncontrolled Utility Residual Oil Boilers*[10] More specifically, the NPS workbook shows the following baseline distributions for the PM species from No. 6 fuel oil for Unit 1:

- Coarse PM (PMC) = 20.0%
- Fine soil (modeled as PMF) = 49.7%
- Fine elemental carbon (modeled as EC) =4.0 %
- Organic condensable PM (modeled as SOA) =4.0%
- Inorganic condensable PM (modeled as SO4) = 22.4%

Brame Unit 2

Since Brame Unit 2 is not available in the LA SIP, the SO_2 and NO_x emission rates were obtained from EPA's Clean Air Markets Division (CAMD) database and reflectthe highest actual 24-hour emission rates based on 2000-2004 continuous emissions monitoring system (CEMS) data. Total PM_{10} emission rates for Brame Unit 2 are based on 2014 stack test data. The emission rates for the PM_{10} species reflect the breakdown of the PM_{10} determined from the National Park Service (NPS) "speciation spreadsheet" for*Dry Bottom Boiler Burning*

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[9] LDEQ. LA Regional Haze SIP, Table 9.2: BART-eligible facilities closest to Caney Creek

[10] The NPS Workbook, "Uncontrolled Utility Residual Oil Boiler.xls" updated 03/2006, was obtained from the NPS website: http://www.nature.nps.gov/air/Permits/ect/index.cfm. The following parameters were input into the workbook for speciation determination for Nesbitt I: #6 oil with a sulfur content of 0.304%, and a heat input of 5,004 MMBtu/hr.

Pulverized Coal using only ESP[11]. Specifically, the NPS workbook shows the following baseline distribution for the PM species:

- Coarse PM (PM_C) = 47.2 %
- Fine soil (modeled as PM_F) = 36.4 %
- Fine elemental carbon (modeled as EC) = 1.4 %
- Organic condensable PM (modeled as SOA) = 15.0 %
- Inorganic condensable PM (modeled as SO_4) = 0 %

An SO_4 emission rate was independently calculated using an EPRI methodology that considers the SO_2 to SO_4 conversion rate and SO_4 reduction factors for various downstream equipment.[12] This SO_4 rate was used in the modeling instead of the rate resulting from the NPS-based breakdown.

Teche Unit 3

The SO_2, NO_x, and PM_{10} emission rates for Teche Unit 3 were obtained from the previously submitted LA SIP. The emission rates for the PM_{10} species reflect the breakdown of the PM_{10} determined from the National Park Service (NPS) "speciation spreadsheet" for *Uncontrolled Utility Residual Oil Boilers*.[13] The NPS workbook shows the following baseline distributions for the PM species from No. 2 fuel oil for Unit 3:

- Coarse PM (PMC) = 19.9%
- Fine soil (modeled as PMF) = 49.5%
- Fine elemental carbon (modeled as EC) = 4.0 %
- Organic condensable PM (modeled as SOA) = 4.0%
- Inorganic condensable PM (modeled as SO4) = 22.7%

BASELINE VISIBILITY IMPAIRMENT

Trinity conducted modeling to determine the visibility impairment attributable to Brame Units 1 and 2, and Teche Unit 3 in two Class I Areas: Caney Creek Wilderness (CACR) and Breton Wilderness (BRET) using the CALPUFF dispersion model.

Table 4-2 and Table 4-3 provide a summary of the modeled visibility impairment attributable to Brame Units 1 and 2 and Teche Unit 3 at CACR and BRET based on the emission rates shown in Table 4-1.

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[11] The NPS Workbook, "PC Dry Bottom ESP Example.xls" updated 03/2006, was obtained from the NPS website: http://www.nature.nps.gov/air/Permits/ect/index.cfm. The following parameters were input into the workbook for speciation determination: total PM_{10} emission rate of 192.5 lb/hr, heat value of 8,500 Btu/lb, sulfur content of 0.31%, ash content of 4.9%.

[12] Electric Power Research Institute (EPRI) Estimating Total Sulfuric Acid Emissions from Stationary Power Plants: EPRI, Technical Update, Palo Alto, CA: March 2012. 1023790.

[13] Ibid.

Table 4-2. Baseline Visibility Impairment Attributable to Brame Units 1 and 2

Year	Maximum (Δdv)	98th Percentile (Δdv)	98th Percentile % SO_4	98th Percentile % NO_3	98th Percentile % PM_{10}	98th Percentile % NO_2
	Caney Creek Wilderness					
2001	1.971	1.170	70.93	28.10	0.97	0
2002	2.535	1.045	31.71	63.52	2.49	2.28
2003	2.551	1.215	94.10	4.11	1.75	0.04
	Breton Wilderness					
2001	1.846	1.060	58.44	40.25	1.23	0.08
2002	1.054	0.474	31.58	63.51	1.67	3.24
2003	2.526	1.044	83.65	14.80	1.54	0

Table 4-3. Baseline Visibility Impairment Attributable to Teche Unit 3

Year	Maximum (Δdv)	98th Percentile (Δdv)	98th Percentile % SO_4	98th Percentile % NO_3	98th Percentile % PM_{10}	98th Percentile % NO_2
	Caney Creek Wilderness					
2001	0.134	0.106	37.94	58.87	2.29	0.90
2002	0.190	0.064	33.92	62.54	3.53	0.01
2003	0.182	0.099	68.09	26.18	5.71	0.02
	Breton Wilderness					
2001	0.688	0.243	52.49	44.4	2.89	0.21
2002	0.376	0.179	31.14	66.31	2.38	0.17
2003	0.491	0.299	64.77	32.14	3.08	0.02

CONCLUSIONS

Based on the results of this screening analysis, absent any further analysis,[14] Brame Units 1 and 2 are determined to be BART-affected emission units. Visibility impacts from Teche Unit 3 are less than the 0.5Δdv screening threshold, and therefore, is not subject to BART.

[14] Cleco is considering options for alternate analyses (e.g., using CAM_X) that may potentially demonstrate inapplicability.

APPENDIX A: OZONE DATA FILES (CD)

APPENDIX B: PM SPECIATION CALCULATIONS

Cleco, Teche III (Unit 3)

Controlled PM10 Speciation from AP-42 Tables 1.3-2 & 1.3-4
Uncontrolled Utility Residual Oil Boiler

Assumes firing of # 2 oil with a sulfur content of 0.29 %S; therefore, A = 0.6976 f(RH) = 1
Assumes heating value of 140,313 Btu/Gal and a heat input of 4,074 mmBtu/hr

Boiler	Uncontrolled PM10 Emissions (**Bold** Values from Tables 1.3-2 and 1.3-4.)															
Boiler	Total PM10	Filterable	Coarse	Ext.	Fine	Fine Soil	Ext.	Fine EC	Ext.	Condensible	CPM IOR	Particle		CPM OR	Particle	
Type	(lb/mGal)	(lb/mGal)	(lb/mGal)	Coef.	(lb/mGal)	(lb/mGal)	Coef.	(lb/mGal)	Coef.	(lb/mGal)	(lb/mGal)	Type	Ext.Coef.	(lb/mGal)	Type	Ext.Coef.
Utility	5.62	**4.12**	1.12	0.6	**3.00**	2.78	1	0.22	10	**1.5**	1.28	SO4	3*f(RH)	0.23	SOA	4

Boiler	Uncontrolled PM10 Emissions															
Boiler	Total PM10	Filterable	Coarse	Ext.	Fine	Fine Soil	Ext.	Fine EC	Ext.	Condensible	CPM IOR	Particle		CPM OR	Particle	
Type	(% of Total)	(% of Total)	(% of Total)	Coef.	(% of Total)	(% of Total)	Coef.	(% of Total)	Coef.	(% of Total)	(% of Total)	Type	Ext.Coef.	(% of Total)	Type	Ext.Coef.
Utility	100%	73.3%	19.9%	0.6	53.4%	49.5%	1	4.0%	10	26.7%	22.7%	SO4	3*f(RH)	4.0%	SOA	4

Boiler	Uncontrolled PM10 Emissions															
Boiler	Total PM10	Filterable	Coarse	Ext.	Fine	Fine Soil	Ext.	Fine EC	Ext.	Condensible	CPM IOR	Particle		CPM OR	Particle	
Type	(lb/mmBtu)	(lb/mmBtu)	(lb/mmBtu)	Coef.	(lb/mmBtu)	(lb/mmBtu)	Coef.	(lb/mmBtu)	Coef.	(lb/mmBtu)	(lb/mmBtu)	Type	Ext.Coef.	(lb/mmBtu)	Type	Ext.Coef.
Utility	0.04	0.03	0.01	0.6	0.02	0.02	1	0.002	10	0.01	0.01	SO4	3*f(RH)	0.002	SOA	4

If you are given Total PM10 emissions in lb/hr:

Boiler	Uncontrolled PM10 Emissions (**Bold** Value is **Input** by user.)															
Boiler	Total PM10	Filterable	Coarse	Ext.	Fine	Fine Soil	Ext.	Fine EC	Ext.	Condensible	CPM IOR	Particle		CPM OR	Particle	
Type	(lb/hr)	(lb/hr)	(lb/hr)	Coef.	(lb/hr)	(lb/hr)	Coef.	(lb/hr)	Coef.	(lb/hr)	(lb/hr)	Type	Ext.Coef.	(lb/hr)	Type	Ext.Coef.
Utility	**144.2**	105.7	28.7	0.6	77.0	71.3	1	5.7	10	38.5	32.7	SO4	3	5.8	SOA	4

Coarse	19.9%	Coarse	28.7	PMC
Fine Soil	49.5%	Fine Soil	71.3	PMF
Fine EC	4.0%	Fine EC	5.7	EC
CPM IOR	22.7%	CPM IOR	32.7	SO_4
CPM OR	4.0%	CPM OR	5.8	SOA
	100.0%		144.2	

Notes:
1. The PM speciation workbook was obtained from National Park Service website (http://www.nature.nps.gov/air/permits/ect/index.cfm)

Cleco, Nesbitt I (Unit 1)

Controlled PM10 Speciation from AP-42 Tables 1.3-2 & 1.3-4
Uncontrolled Utility Residual Oil Boiler

Assumes firing of # 6 oil with a sulfur content of 0.3040 %S; therefore, A = 0.71048 f(RH) = 1
Assumes heating value of 140,726 Btu/Gal and a heat input of 5,004 mmBtu/hr

	Uncontrolled PM10 Emissions (**Bold** Values from Tables 1.3-2 and 1.3-4.)															
Boiler	Total PM10	Filterable	Coarse	Ext.	Fine	Fine Soil	Ext.	Fine EC	Ext.	Condensible	CPM IOR	Particle		CPM OR	Particle	
Type	(lb/mGal)	(lb/mGal)	(lb/mGal)	Coef.	(lb/mGal)	(lb/mGal)	Coef.	(lb/mGal)	Coef.	(lb/mGal)	(lb/mGal)	Type	Ext.Coef.	(lb/mGal)	Type	Ext.Coef.
Utility	5.69	**4.19**	1.14	0.6	**3.06**	2.83	1	0.23	10	**1.5**	1.28	SO4	3*f(RH)	0.23	SOA	4

	Uncontrolled PM10 Emissions															
Boiler	Total PM10	Filterable	Coarse	Ext.	Fine	Fine Soil	Ext.	Fine EC	Ext.	Condensible	CPM IOR	Particle		CPM OR	Particle	
Type	(% of Total)	(% of Total)	(% of Total)	Coef.	(% of Total)	(% of Total)	Coef.	(% of Total)	Coef.	(% of Total)	(% of Total)	Type	Ext.Coef.	(% of Total)	Type	Ext.Coef.
Utility	100%	73.6%	20.0%	0.6	53.7%	49.7%	1	4.0%	10	26.4%	22.4%	SO4	3*f(RH)	4.0%	SOA	4

	Uncontrolled PM10 Emissions															
Boiler	Total PM10	Filterable	Coarse	Ext.	Fine	Fine Soil	Ext.	Fine EC	Ext.	Condensible	CPM IOR	Particle		CPM OR	Particle	
Type	(lb/mmBtu)	(lb/mmBtu)	(lb/mmBtu)	Coef.	(lb/mmBtu)	(lb/mmBtu)	Coef.	(lb/mmBtu)	Coef.	(lb/mmBtu)	(lb/mmBtu)	Type	Ext.Coef.	(lb/mmBtu)	Type	Ext.Coef.
Utility	0.04	0.03	0.01	0.6	0.02	0.02	1	0.002	10	0.01	0.01	SO4	3*f(RH)	0.002	SOA	4

If you are given Total PM10 emissions in lb/hr:

	Uncontrolled PM10 Emissions (**Bold** Value is **Input** by user.)															
Boiler	Total PM10	Filterable	Coarse	Ext.	Fine	Fine Soil	Ext.	Fine EC	Ext.	Condensible	CPM IOR	Particle		CPM OR	Particle	
Type	(lb/hr)	(lb/hr)	(lb/hr)	Coef.	(lb/hr)	(lb/hr)	Coef.	(lb/hr)	Coef.	(lb/hr)	(lb/hr)	Type	Ext.Coef.	(lb/hr)	Type	Ext.Coef.
Utility	**245.0**	180.4	48.9	0.6	131.5	121.8	1	9.7	10	64.6	54.9	SO4	3	9.7	SOA	4

Coarse	20.0%	Coarse	48.9	PMC
Fine Soil	49.7%	Fine Soil	121.8	PMF
Fine EC	4.0%	Fine EC	9.7	EC
CPM IOR	22.4%	CPM IOR	54.9	SO_4
CPM OR	4.0%	CPM OR	9.7	SOA
	100.0%		245.0	

Notes:
1. The PM speciation workbook was obtained from National Park Service website (http://www.nature.nps.gov/air/permits/ect/index.cfm)

Cleco, Rodemacher II (Unit 2)

Controlled PM10 Speciation from AP-42 Tables 1.1-5 & 1.1-6
Dry Bottom Boiler burning Pulverized Coal using only ESP for Emissions control

assumes heating value of 8757 Btu/lb and a sulfur content of 0.45 % and an ash content of 5.53 % and a heat input of 6,534 mmBtu/hr and f(RH) = 1

	Controlled PM10 Emissions(**Bold** values from Table 1.1-5.)															
Boiler Type	Total PM10 (lb/mmBtu)	Filterable (lb/mmBtu)	Coarse (lb/mmBtu)	Ext. Coef.	Fine (lb/mmBtu)	Fine Soil (lb/ton)	Ext. Coef.	Fine EC (lb/mmBtu)	Ext. Coef.	Condensible (lb/mmBtu)	CPM IOR (lb/mmBtu)	Particle Type	Ext.Coef.	CPM OR (lb/mmBtu)	Particle Type	Ext.Coef.
PC-DB	0.0321	0.0171	0.0095	0.6	0.0076	0.0073	1	0.0003	10	**0.015**	**0.012**	SO4	3*f(RH)	**0.003**	SOA	4

	Controlled PM10 Emissions(**Bold** Values from Table 1.1-6.)															
Boiler Type	Total PM10 (lb/ton)	Filterable (lb/ton)	Coarse (lb/ton)	Ext. Coef.	Fine (lb/ton)	Fine Soil (lb/ton)	Ext. Coef.	Fine EC (lb/ton)	Ext. Coef.	Condensible (lb/ton)	CPM IOR (lb/ton)	Particle Type	Ext.Coef.	CPM OR (lb/ton)	Particle Type	Ext.Coef.
PC-DB	0.561	**0.299**	0.166	0.6	**0.133**	0.128	1	0.005	10	0.263	0.210	SO4	3*f(RH)	0.053	SOA	4

	Controlled PM10 Emissions															
Boiler Type	Total PM10 (% of Total)	Filterable (% of Total)	Coarse (% of Total)	Ext. Coef.	Fine (% of Total)	Fine Soil (% of Total)	Ext. Coef.	Fine EC (% of Total)	Ext. Coef.	Condensible (% of Total)	CPM IOR (% of Total)	Particle Type	Ext.Coef.	CPM OR (% of Total)	Particle Type	Ext.Coef.
PC-DB	100%	53.2%	29.6%	0.6	23.6%	22.8%	1	0.9%	10	46.8%	37.4%	SO4	3*f(RH)	9.4%	SOA	4

If you are given Total PM10 emissions in lb/hr:

	Controlled PM10 Emissions(**Bold** Value is **Input** by user.)															
Boiler Type	Total PM10 (lb/hr)	Filterable (lb/hr)	Coarse (lb/hr)	Ext. Coef.	Fine (lb/hr)	Fine Soil (lb/hr)	Ext. Coef.	Fine EC (lb/hr)	Ext. Coef.	Condensible (lb/hr)	CPM IOR (lb/hr)	Particle Type	Ext.Coef.	CPM OR (lb/hr)	Particle Type	Ext.Coef.
PC-DB	**189.6**	100.9	56.0	0.6	44.8	43.2	1	1.7	10	88.7	71.0	SO4	3	17.7	SOA	4

Notes:
1. The PM speciation workbook was obtained from National Park Service website (http://www.nature.nps.gov/air/permits/ect/index.cfm)

Override the estimated CPM IOR to the H_2SO_4 value calculated with EPRI methodology (below).

CMP IOR		0.00 lb/hr	(SO_4)

Redistribute remainder of total PM_0: 189.6 lb/hr

Coarse	47.2%	89.57 lb/hr	(PMC)
Fine Soil	36.4%	69.01 lb/hr	(PMF)
Fine EC	1.4%	2.65 lb/hr	(EC)
CPM OR	15.0%	28.37 lb/hr	(SOA)

EPRI, *Estimating Total Sulfuric Acid Emissions from Stationary Power Plants (1023790)* March 2012

TSAR = Total sulfuric acid (H_2SO_4) release, lbs/yr

= $\{[(EM_{Comb} + EM_{SCR} + EM_{FGC\_beforeAPH}) - (NH3_{SCR} + NH3_{FGC\_beforeAPH})] * F2_{APH} + (EM_{FGC\_afterAPH} - NH3_{FGC\_afterAPH})\} * F2_x$

= -89,877.58 lb/year

where:

EM_{Comb} = H_2SO_4 manufactured from combustion, lbs/yr

= K * F1 * E2

= 140,067.00 lb/year

where K = Units conversion factor

= 3063 lb H_2SO_4/ton SO_2

F1 = Fuel Impact Factor (PRB coal, all boiler types)

= 0.0019 *unitless*

E2 = SO_2 emission rate, tons/yr

= 24,067.74 tons/yr (max. day during '00-'04)

EPRI (Continued)

EM_{SCR} = H_2SO_4 manufactured from SCR
= 0 lb/year

EM_{FGC} = H_2SO_4 manufactured from flue gas conditioning
= $EM_{FGC\_beforeAPH}$ $EM_{FGC\_afterAPH}$ = 0
= $K_e * B * f_e * I_s * F3_{FGC}$
= 0 lb/year

$NH3_{SCR}$ = Ammonia slip produced from SCR/SNCR
= $K_s * B * f_{sreagent} * S_{NH3}$

where K_s = Conversion factor
= 3799 lb H_2SO_4/(TBtu*ppmv SO_3 @ 6% O_2 and wet)

B = Coal burn, Tbtu/yr
= 34.61 TBtu/yr (average for '00-'04)

$f_{sreagent}$ = fraction of SCR operation wih reagent injection
= f_{sops} = 0.43 unitless (for seasonal operation)

S_{NH3} = NH_3 slip from SCR/SNCR, ppmv at 6% O2
= 5 ppmv (SNCR average, presented in Eqn 4-12)

= 282729.8169 lb/year

$F2_{APH}$ = Technology impact factor for APH; only apply if [(EM_{comb} + EM_{SCR} + $EM_{FGC\_beforeAPH}$) - ($NH3_{SCR}$ + $NH3_{FGC\_beforeAPH}$)] is positive
= 0.36 for air heater

$NH3_{FGC}$ = Ammonia produced from FGC
= $NH3_{FGC\_beforeAPH}$ $NH3_{FGC\_afterAPH}$ = 0
= $K_e * B * f_e * I_{NH3}$
= 0 lb/year   No FGC is present

$F2_X$ = Technology impact factors for processes downstream of the APH (sum of all that apply)
= 0.63 for hot-side ESP

Notes:
1. Unit 2 is a dry-bottom, wall-fired boiler that burns PRB coal (currently with a sulfur equivalent to 0.55 lbs SO_2/MMBtu) with an ESP (hot-side). There is no flue gas conditioning for PM.
2. Ammonia solution is injected through the SNCR during the ozone season, but it is injected downstream of the ESP.
3. Unit 2 has been retrofitted with: LNB (installed several years ago), SNCR, and DSI.
4. Unit 2 has an air preheater.
5. SO4 emissions are calculated using the EPRI Method, as outlined in the reference document:
"Estimating Total Sulfuric Acid Emissions from Stationary Power Plants". Electric Power Research Institute (EPRI). Technical Update, March 2012.